7313 William Barry Blvd.
N. Syracuse NY, 13212
United States
1-800-365-5525
info@icmcontrols.com



ELECTRICAL DISTURBANCES & POWER QUALITY RELIABILITY IN THE AGE OF DATA CENTERS

WHAT THE CHANGING GRID MEANS FOR HVAC/R CONTRACTORS, COMMERCIAL FACILITIES, AND HOMEOWNERS

USA INNOVATION

www.icmcontrols.com

EXECUTIVE SUMMARY

Data center growth is real, but its effects on the electrical grid are local and conditional. The impact depends on generation capacity, grid upgrades, where new loads connect, and whether data centers can adjust their electrical demand. Rapid growth may increase strain and investment needs in some areas; well-managed projects can also support modernized infrastructure and new grid services. [1, 3, 4, 6]

In June 2026, Lawrence Berkeley National Laboratory estimated that data centers could account for 11.8% of U.S. electricity use in 2030 in its reference case, with scenarios spanning 9.5% to 15.3%. The International Energy Agency (IEA) projects global data center electricity consumption of roughly 950 TWh by 2030, up from 485 TWh in 2025. Different geographies and methods explain why these figures should not be directly compared. [1, 2]

For an HVAC/R contractor, the useful response is not to assume every new data center causes damaging voltage swings at nearby homes. It is to measure what is happening at the customer's equipment, identify actual risks, and propose appropriate protection and efficiency improvements. [4, 5, 12, 13, 14, 15, 16, 17, 18, 19, 20, 21]

1. More electricity demand does not automatically equal poor power quality. 2. Surge protection and voltage monitoring address different electrical problems. 3. The next five years favor contractors who can combine cooling expertise, diagnostic skills, controls, maintenance, and equipment protection.

AT A GLANCE: THE SCALE OF GROWTH



Global data center electricity consumption, reported 2025 level and IEA 2030 central outlook. Source: IEA, April 2026. [2]

1 | WHAT IS CHANGING ON THE ELECTRICAL GRID?

A data center is a facility filled with computing, networking, power-conversion, and cooling equipment. AI oriented facilities can be especially power-intensive because processors operate in synchronized workloads. Demand is expanding alongside other drivers such as transportation electrification, air conditioning, heat pumps, and industrial activity. IEA projects data centers will contribute about half of U.S. electricity-demand growth through 2030. [2, 8]

Many projects request grid connections faster than utilities can add substations, transformers, transmission lines, and generating resources. Some proposed projects will be delayed or never built, so forecasts must account for uncertainty. NERC has elevated large-load integration as a reliability planning concern, while the IEA warns that poor coordination can increase local costs and delays. [3, 4]

Capacity, reliability, and power quality are not interchangeable

Concept	Plain-language meaning	Why HVAC/R should care
Grid capacity	Can the system supply enough power at the needed time?	Affects connection timelines, peak-demand planning, and shortage risk.
Grid reliability	Does electricity stay available through normal conditions and disturbances?	Outages can stop heating, cooling, and refrigeration.
Power quality	Is the voltage waveform within equipment operating tolerances?	Surges, sags, swells, and phase faults can cause nuisance trips or damage.
Energy efficiency	How much useful cooling or heating is delivered per unit of energy?	Better controls, design, and maintenance can reduce use and cost.

Important: A city can face rising electricity prices or capacity limitations without every building experiencing unusual voltage disturbances. Conversely, a facility can have poor power quality due to local wiring, switching, motors, or utility events even without a nearby data center.

2 | WHAT COUNTS AS AN ELECTRICAL DISTURBANCE?

Condition	What it means	Potential HVAC/R symptom
Transient surge	A brief spike in voltage, often from switching or lightning-related events.	Damaged control electronics or protective device operation.
Voltage sag/ under voltage	Voltage falls below normal for a brief or sustained interval.	Motor stress, contactor dropout, nuisance shutdown.
Voltage swell / over voltage	Voltage rises above the normal operating range.	Extra stress on motors, insulation, and electronics.
Interruption	Supply is lost briefly or for an extended period.	Cooling outage and potentially difficult restarts.
Phase loss, reversal, unbalance	A three-phase supply loses a phase, reverses phase order, or has unequal voltages.	Three-phase motor overheating, incorrect operation, shutdown.
Harmonics / waveform distortion	The electrical waveform differs from a clean sine wave.	Possible heating or compatibility issues; requires specialized diagnosis.

These disturbances have many possible causes: electrical faults, lightning, utility switching, local load starts, inadequate connections, or facility equipment. In a May 2026 technical note, the U.S. Department of Energy described oscillating loads from some AI computing operations as a grid-monitoring issue. That is not proof that a particular nearby home or compressor is experiencing harmful voltage. [5]

TWO DIFFERENT TOOLS, TWO DIFFERENT JOBS

Surge protective device (SPD): Helps limit brief transient over voltages. Voltage monitor: Detects abnormal sustained or time-qualified voltage/phase conditions and, when correctly paired with control hardware, can disconnect or inhibit equipment operation. Neither is a voltage regulator, UPS, full backup system, or universal remedy for harmonics. [12, 13, 14, 15, 16, 17, 18, 19, 20, 21]

3 | ARE DATA CENTERS BAD FOR THE ELECTRICAL GRID?

Not inherently. A data center is a large electricity customer. Whether it helps or harms local system performance is determined largely by the load profile, interconnection design, existing grid conditions, financing, and operating agreements. The IEA's October 2026 review describes trade-offs involving grid connection, affordability, water use, emissions, and reliability. [3]

Potential challenge	Potential benefit or mitigation
Large concentrated loads can outpace transmission, transformer, or generation additions.	New infrastructure investment, realistic connection queues,and phased commissioning can align growth with supply.
Uncertain or speculative project pipelines can lead to underbuilt or overbuilt assets.	Better forecasting and coordinated siting can improve planning and use of existing capacity.
AI workloads may produce rapid changes in power demand.	Storage, workload scheduling, advanced controls, and technical interconnection rules may improve flexibility.
Electricity bills and water use may rise in some locations.	Rate design, cost-allocation rules, efficient cooling, and technology choices can address some impacts.

NERC has documented large-load behavior during grid events, including rapid load reductions that can affect system frequency or voltage. Those findings warrant engineering attention, not blanket claims that all data centers destabilize neighboring HVAC equipment. [4]

The opportunity for a more positive outcome is genuine. IEA's 2026 work finds that data centers can offer demand flexibility, although economic and operational barriers remain. Battery storage, on-site resources, and coordinated computing schedules may help if the incentives and technical controls are correct. [2, 6]

BALANCED CONCLUSION
A data center can increase a region's need for generation and grid investment; it can also be an anchor customer for upgrades and new efficiency technologies. There is no nationwide yes-or-no answer. The meaningful question is: How is a specific project integrated into its local electric system?

4 | WHAT THIS MEANS FOR CONTRACTORS AND HOMEOWNERS

For HVAC/R contractors

The contractor's business opportunity is to move from repair-only conversations to documented reliability and efficiency plans. Power-quality knowledge becomes especially valuable for commercial rooftop units, mini-splits, refrigeration systems, pumps, chillers, and three-phase equipment—but an assessment should begin with measured symptoms, not fear-based assumptions.

1. **Ask better questions.** Has the customer experienced nuisance trips, blown boards, compressor failures, power interruptions, or recurring fault codes? Record dates, weather, and utility events.
2. **Inspect and measure.** Confirm grounding/bonding, supply voltage, circuit condition, phase balance, and equipment nameplate requirements. Use appropriate qualified personnel and test instruments.
3. **Separate problems.** Distinguish a transient surge from a sustained voltage fault, phase issue, mechanical failure, control problem, and energy inefficiency.
4. **Specify the right layer.** Where justified, select a properly rated SPD, appropriate monitor and control interface, plus manufacturer-approved restart timing.
5. **Offer a service plan.** Review fault history, protective-device status, controls settings, seasonal performance, and maintenance at scheduled visits.

For homeowners
A nearby data center does not mean your home HVAC system will necessarily receive poorer power. Ask a qualified contractor to investigate repeated failures or shutdowns. Protection may help reduce exposure to specified electrical disturbances, but comfort and lower utility bills also depend on equipment sizing, ductwork, controls, insulation, and maintenance. [3, 4, 5]

PLAIN-LANGUAGE CUSTOMER EXPLANATION
"We cannot stop a utility outage, but we can check for electrical risks at the equipment and discuss protection options. A surge protector helps with sudden spikes. A properly configured voltage monitor helps manage operation when voltage moves outside safe limits. Neither replaces maintenance or an efficient HVAC design."

5 | HVAC/R INDUSTRY OUTLOOK: 2027–2031

This section is a directional outlook, not a precise market-size forecast. Public reports provide quantified outlooks mainly through 2030; the 2031 direction extrapolates the documented drivers and should be revisited annually. BLS projects 11% growth in HVAC/R mechanic and installer employment from 2025 to 2035 and explicitly identifies commercial construction including data centers among demand drivers. [9]

Area	2027-2031 direction	What to watch
Commercial cooling and refrigeration	Likely growth in mission-critical and retrofit work; regionally uneven.	Data center builds, process cooling, facilities retrofits, capital spending. [2, 3, 9]
Liquid-cooling infrastructure	Likely rapid growth from a relatively small base in high-density compute.	Pumps, heat exchangers, distribution units, water treatment, leak detection, controls. [7]
Controls, diagnostics, monitoring	Likely growth as customers seek reliable operation and measurable performance.	Fault histories, monitoring integration, commissioning, service agreements. [4, 11]
Electrical protection add-ons	Opportunity for growth, tied to demonstrated risks and customer economics.	SPDs, phase/voltage monitors, engineered coordination, training. [12, 13, 14, 15, 16, 17, 18, 19, 20, 21, 22]
Traditional air-only cooling in dense AI halls	May lose share where liquid-assisted designs are more effective.	Facility design shifts; air cooling remains necessary for many loads. [7]
Commodity residential unit shipments	Uneven / cyclical, not a straightforward data-center growth story.	Replacement cycles, financing, housing activity, channel inventory. [10]

The IEA 4E program reports modeled overall energy-saving potential of approximately 10%–21% from liquid-cooling approaches across assessed cases, with adoption constrained by cost, standardization, and reliability concerns. These are study estimates—not guaranteed project savings. [7]

In contrast, HVAC distributor organization HARDI documented weak U.S. unitary equipment shipments early in 2026 after earlier inventory build-up around the technology transition. That near-term weakness should not be interpreted as a five-year contraction in all HVAC/R applications. [10]

What could change this outlook?
- **Upside:** Faster interconnections, sustained compute investment, cooling-system retrofits, stronger service demand, and better efficiency economics. [2, 3, 7]
- **Downside:** Delayed data center projects, transformer and equipment shortages, financing constraints, restrictive siting or resource conditions, and slower commercial construction. [2, 3]

- **Always relevant:** Traditional HVAC/R replacement, maintenance, reliability, and skilled labor needs persist beyond the data center segment. [9]

6 | WHERE ICM CONTROLS CAN HELP

ICM Controls supplies components for equipment-level protection and control, not transmission-system stabilization. Its product categories include single- and three-phase SPDs, line-voltage monitors, and combined surge/voltage protection solutions. ICM also lists data center applications in its official industry portfolio. [12, 13, 14, 15, 16, 17, 18, 19, 20, 21, 22]

Residential and light-commercial applications

IMPORTANT PRODUCT SELECTION NOTE
Never select protection by building type alone. Match nominal voltage, phase configuration, rated current, SCCR / available fault current, installation point, enclosure, coordination, and equipment manufacturer instructions. A stand-alone monitor with relay contacts is not automatically a full-load disconnect. Product availability and specifications may change; always consult the current ICM datasheet and installation guide. [12, 13, 14, 15, 16, 17, 18, 19, 20, 21]

7 | Best-fit applications and practical service packages

Most contractors will encounter the largest immediate opportunity in existing equipment, where downtime, repeated failures, or fault histories can motivate a documented assessment. Data center ownership is not required for an HVAC/R customer to benefit from a thoughtful electrical protection conversation.

Customer profile	Conversation starter	Potential service package
Homeowner with nuisance HVAC shutdowns	"When did the fault occur and what did your contractor measure?"	Electrical inspection, system diagnostics, suitable SPD or monitoring, maintenance.
Light-commercial property / restaurant	"How much does a failed condenser or refrigeration circuit cost in lost service?"	Voltage and surge assessment, control verification, scheduled inspections.
Commercial rooftop-unit portfolio	"Are failures clustered by building or electrical service?"	Fault-history review, three-phase protection review, coordinated maintenance.
Data center auxiliary cooling / supporting facility loads	"Which pumps, condensers, CRAH/CRAC auxiliaries, or electrical panels have documented risks?"	Site-engineered selection with facility electrical engineer; coordinated monitoring and controls.

ICM solutions may be suitable for auxiliary cooling and equipment-level circuits when their electrical specifications match the application. They should not be described as complete data center power-quality correction, facility UPS systems, medium-voltage grid solutions, or replacements for engineered protective coordination. [17, 18, 19, 20, 21, 22]

A repeatable five-step contractor offer

1. Document the risk: Collect equipment model, age, failure history, and electrical symptoms.

2. Verify the source: Test voltage, phase condition, grounding, connections, and appropriate power-quality metrics.
3. Recommend a layered solution: Consider appropriate SPDs, voltage/phase monitoring, restart timing, and coordinated electrical protection.
4. Improve efficiency separately: Check controls setup, refrigerant-side condition, airflow, heat transfer, sequencing, and planned maintenance.
5. Prove the value: Record baseline conditions, installed protection, fault logs, service calls, and operating performance over time.

8 | FREQUENTLY ASKED QUESTIONS

Will a new data center cause my home HVAC system to fail?
Not necessarily. A nearby data center does not establish that the home has abnormal voltage. Investigate specific symptoms and verify utility and building electrical conditions before drawing conclusions. [3, 4, 5]

Will surge protection lower my electric bill?
No direct energy-saving claim should be made. SPDs manage transient surges. Efficiency improvements typically come from appropriate equipment sizing, controls, system design, and maintenance. [12, 13, 24]

Does a voltage monitor keep my equipment running through an outage?
No. It can signal abnormal conditions and—when installed in an appropriate control arrangement—help disconnect and delay restarting. It does not provide backup electricity. [14, 15, 19, 20, 21]

Are data centers creating more contractor business?
They create potential demand for commercial cooling, controls, commissioning, and service, but project timing and geography matter. The 2025–2035 BLS HVAC/R employment projection is positive nationally; it is not a revenue forecast for any individual contractor. [2, 3, 9]

What can a homeowner ask a contractor today?
Ask whether the HVAC circuit has been evaluated for repeated voltage faults, what protections the equipment manufacturer permits, and whether maintenance or controls issues contribute to repeated shutdowns. A licensed professional should make any electrical modifications.

CONCLUSION | THE NEXT COMPETITIVE ADVANTAGE IS INFORMED PROTECTION

Data centers are changing how electricity is planned, produced, and delivered. Those changes create real grid management challenges and opportunities to modernize infrastructure. Neither fear nor blanket optimism is warranted. For HVAC/R professionals, the most useful response is verified diagnosis, appropriate equipment protection, better controls, and thoughtful maintenance. [1, 2, 3, 4, 5, 6, 7, 8, 9]

ICM Controls can support that response with single-phase and three-phase surge protection, voltage monitoring, and combination solutions in suitable applications. Contractors who connect the right technical diagnosis to the right customer need can offer greater reliability while building ongoing service relationships. [12, 13, 14, 15, 16, 17, 18, 19, 20, 21, 22]

CONTRACTOR CALL TO ACTION

At your next maintenance visit, ask: “Have we documented this unit’s electrical risks—not just its mechanical condition?” Use the findings to discuss protection, operational reliability, and efficiency as three related but separate parts of the service plan.

Explore product families, technical guides, and current specifications: www.icmcontrols.com

Sources

[1] Lawrence Berkeley National Laboratory. United States Data Center Energy Usage Report: 2025 Update (June 2026). Source
[2] International Energy Agency. Key Questions on Energy and AI (April 16, 2026). Source
[3] International Energy Agency. Powering Artificial Intelligence: Strategies for Integrating Data Centres into Electricity Systems (October 14, 2026). Source
[4] North American Electric Reliability Corporation. 2025 Long-Term Reliability Assessment (2025; reviewed 2026). Source
[5] U.S. Department of Energy, Office of Electricity. Monitoring Oscillations from Large Data Centers (May 28, 2026). Source
[6] IEA 4E Energy Efficient End-use Equipment. Data Centres and Flexibility (July 1, 2026). Source
[7] IEA 4E Energy Efficient End-use Equipment. Liquid Cooling in Data Centres (June 22, 2026). Source
[8] International Energy Agency. Electricity 2026: Demand (2026). Source
[9] U.S. Bureau of Labor Statistics. Occupational Outlook Handbook: Heating, Air Conditioning, and Refrigeration Mechanics and Installers (2026; 2025-2035 projections). Source
[10] Heating, Air-conditioning & Refrigeration Distributors International. Understanding the Numbers: AHRI Shipment Report Breakdown for January 2026 (April 7, 2026). Source
[11] International Energy Agency. Modernising Grids in the Age of Electricity (September 21, 2026). Source
[12] ICM Controls. ICM517A product information (Accessed November 2026). Source
[13] ICM Controls. ICM518 product information (Accessed November 2026). Source
[14] ICM Controls. ICM492DX product information (Accessed November 2026). Source
[15] ICM Controls. Sentry 3N1 product information (Accessed November 2026). Source
[16] ICM Controls. ICM493 product information (Accessed November 2026). Source
[17] ICM Controls. ICM530 three-phase SPD product information (Accessed November 2026). Source
[18] ICM Controls. ICM531 three-phase SPD product information (Accessed November 2026). Source
[19] ICM Controls. ICM450A / ICM450A PLUS+ product information (Accessed November 2026). Source
[20] ICM Controls. 3VMS-60-208 product information (Accessed November 2026). Source
[21] ICM Controls. 3VMS-60-480 product information and installation guide (2026). Source
[22] ICM Controls. Data Center industry applications page (Accessed November 2026). Source
[23] U.S. Energy Information Administration. Short-Term Energy Outlook: Electricity (October 2026). Source
[24] U.S. Department of Energy / Lawrence Berkeley National Laboratory. Best Practices Guide for Energy Efficient Data Center Design (2024; updated web edition). Source

Editorial and technical limitations

This report is educational, not engineering advice or a product design specification. Local utility conditions, connected load behavior, and project economics vary. Projections describe scenarios; 2031 directional assessments are informed interpretation, not published forecasts. Proper electrical installation requires qualified personnel, relevant codes, OEM instructions, and coordination with the facility design professional. ICM products may reduce exposure to specified faults; no product prevents all failures, guarantees uninterrupted operation, or independently increases HVAC efficiency.

How to read this white paper

Terms are explained in plain language first. Application examples are directional—not installation instructions. Product selection requires verification against actual equipment nameplate data, electrical configuration, manufacturer instructions, and applicable codes.